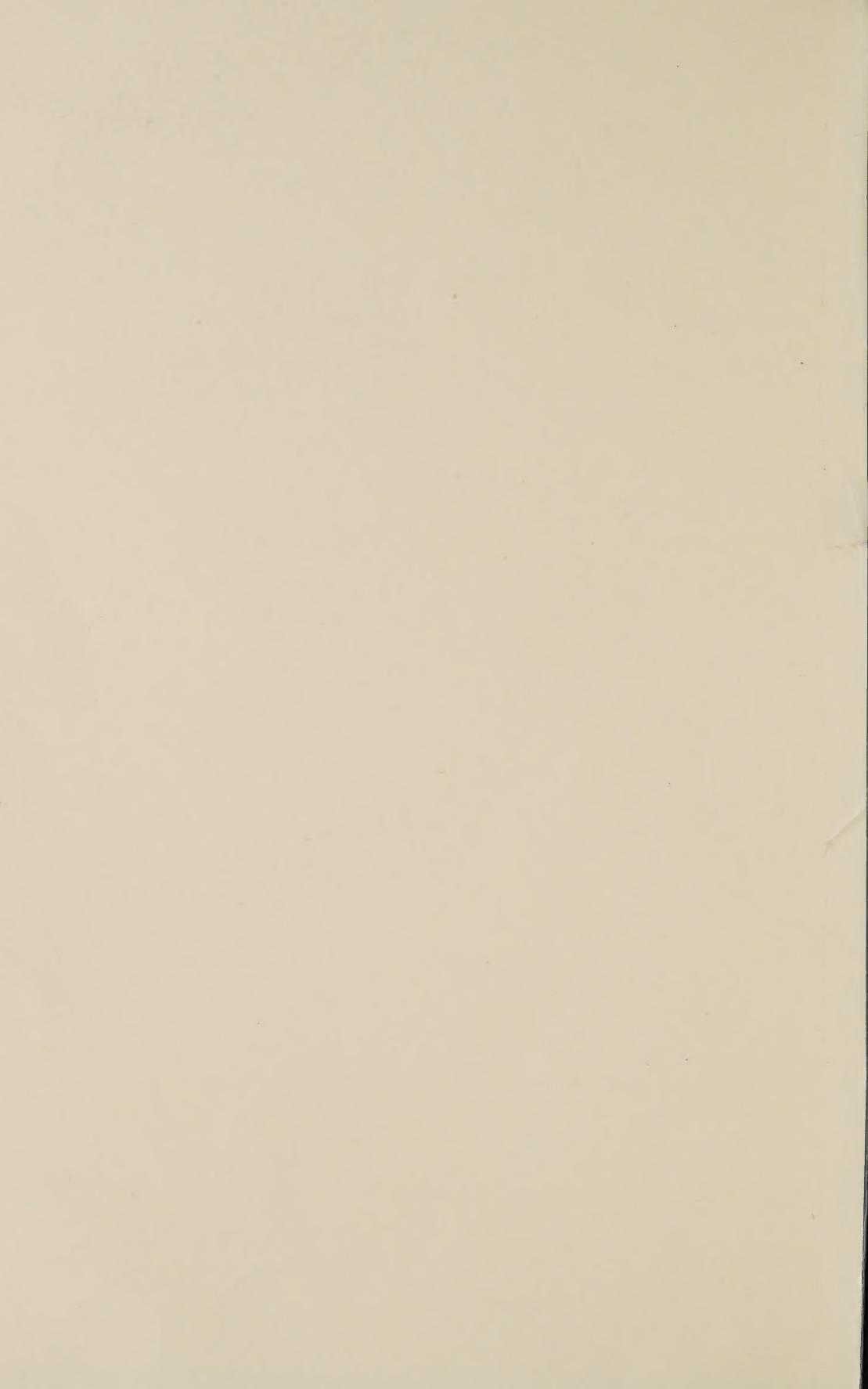


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# Dwarf mistletoe of *Ponderosa Pine* in the Southwest

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The dwarf mistletoe attacking ponderosa pine in Arizona, Colorado, New Mexico, and Utah is *Arceuthobium vaginatum* (Willd.) Presl. The parasite occurs throughout the range of ponderosa pine in these States and is present on at least one-third the commercial acreage. It is responsible for a 16-percent reduction in ponderosa pine sawtimber growth and also causes heavy mortality. It is distinct from the species (*A. campylopodum* Engelm.) on the same host in the Pacific Coast States, Idaho, and western Montana.

The principal and most valuable tree attacked is ponderosa pine, but the parasite has also been reported on Apache and Chihuahua pines in the United States. It also extends into Mexico.

## Appearance of Infected Stands

Light to moderately attacked stands in which damage is negligible cannot be readily distinguished from healthy stands except by the presence of scattered dwarf mistletoe shoots. Heavily attacked stands give the general impression of poor site conditions. They contain deformed, stunted or dying, and dead trees. Deformities may be witches'-broom confined to a single limb or they may disfigure the entire crown (fig. 1, A and B).

Stunted or dying trees may be the result of top starvation stemming from numerous witches'-brooms in the lower crown or they may be the direct result of scattered infections throughout the tree (fig. 1, B). Many dead trees show the unmistakable branch habit of old

witches'-brooms (fig. 1, C). If young trees are present there is usually evidence of recent killing and always some malformation of the branches.

Very often trees of small pole size and larger have extensive areas of cankerous pitch-soaked bark which indicate longstanding trunk infections. The branches and, to a lesser extent, the boles of infected trees bear dwarf mistletoe shoots or the basal "cups" from which shoots once issued.

## Description of the Pest

Dwarf mistletoe is a seed plant consisting of exposed flower-bearing shoots and a modified root or absorbing system inside the host tissues.

*Shoots* (fig. 2, A) arise on the host stems or branches in which an absorbing system has developed. They are leafless, squarish, jointed, and yellow to green or brownish green in color. They are perennial and therefore variable in length, the old vigorous ones sometimes attaining a length of 12 inches or more and a half-inch basal diameter.

*Flowers* are borne at the stem joints and are of two types, viz. pollen producers (fig. 2, B) and fruit producers (fig. 2, C). The flowers from a particular system are always the same type. Blooming occurs in May or June, and pollination is accomplished by insects.

*Fruits* (fig. 2, C) are berrylike structures containing a single seed. They mature about 14 months after pollination at which time (late July or early August) the seeds are expelled with an explosive force that may carry them a horizontal distance of 60 feet or more.

<sup>1</sup> Maintained by U. S. Department of Agriculture at Fort Collins, Colo., in cooperation with Colorado State University.



**Figure 1.—Deformities of ponderosa pine caused by dwarfmistletoe:** *A*, Single witches'-broom confined to a living limb; *B*, witches'-brooms scattered throughout the crown of a tree in which the top has died as a result of heavy dwarfmistletoe infection; *C*, witches'-brooms in a tree killed by dwarfmistletoe.

Seeds (fig. 2, *D*) are small ( $\frac{1}{8}$  to  $\frac{1}{16}$  inch long), egg-shaped and usually olive green or reddish brown when dried. They are covered with a sticky hygroscopic substance (viscin) that holds them in place wherever they alight and provides moisture for germination.

### Life History of the Pest

Most seeds germinate within a few weeks after expulsion and form a rootlike radicle that grows until the food supply is exhausted. Infection can occur most easily when the seed adheres to 1- to 3-year-old twig growth although 10-year-old growth is sometimes attacked. When the elongating radicle encounters an obstacle—often the base of a bud or needle bundle sheath (fig. 2, *D*)—it forms a mound of tissue that acts as a holdfast and from which a primary root penetrates into the living host bark.

Out of the primary root come the threadlike strands that develop into the absorbing or feeding system. Some of these strands become

imbedded in the wood as the twig adds its annual rings. These are the "sinkers" which in cross sections of infected twigs appear as yellow V-shaped structures resembling large medullary rays. A minimum of 2 years and usually 4 or more elapse until the first shoots are produced. During this latent period, it is difficult if not impossible to detect the infection.

### Effect on Trees

The first visible sign of dwarfmistletoe infection is a slight swelling of the bark on the host tree. As time passes and the absorbing system becomes more extensive, the branch habit may become distorted into a witches'-broom. As a rule broomed branches outlive their uninfected neighbors by many years. They divert food from the growing top of the tree and thus are instrumental in reducing vigor and causing premature death. Long-lived witches'-brooms also result in excessively large knots; it is not uncommon for the bases of witches'

brooms on otherwise clear trunks to reach 12 inches in diameter.

Often trees may be seriously infected without developing witches'-brooms: mistletoe shoots are abundant and widespread on foliated twigs throughout the crown. The foliage gradually becomes thin, short, and yellowish, and death of the tree follows a variable period of

reduced growth either as a direct result of parasitism or from attack by secondary pests.

In trees up to small pole size, dwarfmistletoe causes premature and sudden death. This is especially true where the absorbing system has become established in the trunk either by direct infection or by invasion from a branch.



Figure 2.—Features of the dwarfmistletoe plant: A, Cluster of leafless perennial shoots that have developed from a single infection close to the base of the living branch; B, part of stem bearing pollen-producing flowers in bloom; C, part of stem bearing immature fruits or berries approximately 1 year old and 2 flowers of the current season; D, germinated seed showing radicle penetrating bark at the base of needle bundle sheath.

## **Effect on Stands**

Severely diseased stands are the result of a continuous intensification of the parasite over a long period. As time passes, the damaged area increases and its productivity decreases. Eventually the dwarf-mistletoe population is depleted either from lack of suitable host trees or as the result of natural control factors. Similarly, in unprotected forests, holocaustic fires certainly have been important in keeping down dwarfmistletoe, but at a tremendous cost in trees and time. Partial burns, on the other hand, may have favored the parasite by leaving scattered infected overstory trees to shower seeds on the surrounding reproduction. Such a condition results in maximum spread and damage.

## **Control**

Tests have not yet uncovered a chemical that can kill the parasite without damaging the host. Similarly, no promising biological controls have been found. Consequently, there is no proved method for reducing dwarfmistletoe populations other than cutting or poisoning the infected trees.

In some cases infections can be effectively pruned out of young trees. Where values are high enough to warrant pruning older trees, as in recreational and administrative areas, the removal of large living brooms should restore the vigor of the trees and prolong their lives. The pruning of trees with numerous scattered infections throughout their crowns should be avoided because ordinarily they require repeated treatment to rid them of latent infections. If shoots are present within 1 foot of the trunk, it is best to assume that the parasite has invaded the tree itself and cannot be eliminated by pruning. In prunable trees, one whorl

above the highest infected branch should be removed to dispose of the bulk of latent infections.

Where values are based on sawtimber production, control must be incorporated with management and silvicultural practices. To be effective, it should be conducted in two steps. Infections are first removed from overstory trees in a harvest cutting. This step should not be taken during the seed dispersal period from mid-July to mid-August to avoid unnecessary spread of infection to the adjacent understory. Two or three years after the harvest cutting, infections are eliminated from the understory by thinning and pruning. Because visible shoots are not produced by the parasite for several years and may remain inconspicuous for several more, a series of 2 or 3 cleaning operations, spaced at 5-year intervals, is necessary to reduce the pest to an innocuous level.

Dwarfmistletoe can be controlled in lightly diseased stands with only slight modifications in current cutting and stand-improvement practices. In severely diseased stands, however, little or no good will be accomplished without heavier than normal cuts and substantial investments in direct control. Fortunately, such stands rarely cover more than 5 to 10 acres, and by rendering them noninfectious larger areas are protected indefinitely.

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